Insect Pests of Theobroma Cacao *in the Territory of Papua and New Guinea: Their Habits and Control.*

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THE insects which are most often found attacking cacao throughout the Territory of Papua and New Guinea are described on the following pages. Included also is a brief description of their life histories and habits, the type of damage they inflict, and a resume of the control methods which are applicable to each.

The insects included are :—

Cacao weevil borers. *Pantorhytes* spp.

Longicorn borers. Family Lamiidae.

Flush defoliating caterpillars. *Achaea janata* L. *Tiracola plagiata* Walk. *Ectropis sabulosa* Warr. *Hyposidra talaca* Wlk.

Mealybugs and scale insects. Family Coccidae.

Aphids. Family Aphididae.

Capsids (mirids). *Pseudodoniella* spp. *Helopeltis clavifer* Walk.

Giant Cacao termite. *Neotermes* sp.

Amblypelta. *Amblypelta* spp.

A short discussion of the various techniques employed in the application of insecticides is to be found here also, in order to help clarify expressions which are commonly used, as well as the theories behind the use of the different methods.

TECHNIQUES FOR THE APPLICATION OF INSECTICIDES.

There are four basic methods of applying insecticides, each of which has use under different conditions. They are : high volume spraying, low volume spraying (also known as misting or concentrate spraying), fogging and dusting. High volume spraying uses large amounts of a very dilute mixture, with water as the carrier, and plants are sprayed until they are thoroughly wet. Misting uses a much smaller amount of spray, which is carried in a high volume of air, the air replacing the water which is used in high volume spraying. In misting the droplets form a discrete pattern, they do not coalesce and there is no run-off—the residue often is not visible to the naked eye. Fogging uses an even smaller amount of spray material, and extremely small droplets are formed—these are carried by natural air movement, rather than the air blast produced by the machine. Fogs are used mostly for interior work, and are generally considered unsatisfactory for outside use as they do not provide adequate residual deposits and coverage because of the reliance on air drift to carry the insecticide. In dusting, the insecticide is carried by movement of the air, and like fogging can be used only when there is little wind.

Under Territory conditions, low volume spraying and dusting are the most popular methods of insecticide application, mainly because of inadequate water supplies and difficulties of terrain.

High Volume Spraying.

This form of spraying is commonly found in the use of hand-pumped knapsack sprayers (Plate I) for the treatment of young cacao or coconuts, e.g., the application of insecticides to young cacao for the control of caterpillars.

Spraying can often be selective and thus the amount of spray material used may be reduced. The limits to the use of knapsacks are in the volume of water required per acre and the height which has to be reached with the insecticide. Dilute mixtures of insecticide are used, for example, for caterpillar control on young cacao an 0.25 per cent. DDT mixture is recommended.

Misting.

Mist spraying is probably the commonest form of insecticide application found in the Territory. The main advantages lie in the low volumes of water required per acre, low cost for the amount

***Plate* I.—A type of hand-operated knapsack sprayer used for high volume application of chemicals.—N.B.—Excess spray running off.**

of insecticide used, and the versatility of modern power-driven shoulder-mounted misting machines. In contrast to the dilute mixtures used in high volume spraying, concentrated mixtures of insecticides are applied, again, for caterpillars on cacao, a 2.5 per cent. DDT solution is recommended.

The disadvantages of misting are that there is less effective deposition of insecticide, compared with high volume application, when equal amounts of active material are applied per acre. As the amount of spray per acre is reduced there is a corresponding decrease in the effective deposition of active material, as a higher percentage of the mist falls to the ground, particularly on young trees.

Dusting.

Dusting is generally used for capsid control in cacao ; however it is probably the most expensive way to apply a given amount of insecticide. For example, in the control of capsid, it costs 8*s.* 10*d.* per acre for each application of BHC dust (at 8 lb. per acre) but only 1*s.* 8*d.* per acre to use an endrin mist for equivalent results (see section on capsids). The main advantage of dusting is in the speed and ease of an application, also, no water or preparation is required. Hand operated machines can be utilized in the treatment of small areas. Apart from expense, dusting is at a disadvantage because of the poor resistance of the deposits to washing by rain.

Plate III.—A shoulder-mounted motor-driven duster in action.

It is important to remember that all these methods are just different ways of applying the insecticide to the plant, and whatever method is used, equal amounts of *actual* insecticide (to a given area) must be used to obtain equivalent results. The second important point is to ensure that an even coverage of the crop is being obtained.

CACAO WEEVIL BORERS.

Pantorhytes spp.

There are five species of *Pantorhytes* recorded as attacking cacao in New Guinea (Plates IV, V, VI and VII) though it is only in New Britain (*P. plutus* Oberth.), the Markham Valley (*P. proximus* Fst.) and the Northern District of Papua (*P. szentivanyi* Mshl.) that the incidence of the weevils is yet sufficiently high to cause serious damage. The adults are wingless and entrance to cacao plantations must be by walking or by human agency.

Life History.

The length of the life cycle from egg to mature adult varies from nine to sixteen months (this has been found for *P. plutus*). The egg is laid in roughened bark or cracks and takes 14 to 16 days to hatch. The larva has a robust curved body, but no legs and bores into the sapwood. After a larval period of six to fourteen months pupation takes place in a fibrous cocoon constructed just beneath the surface of the bark. This stage is short (13 to 22 days); however the young adult undergoes a maturation or hardening period of about 14 days before final emergence. Adults of *P. plutus* have been kept

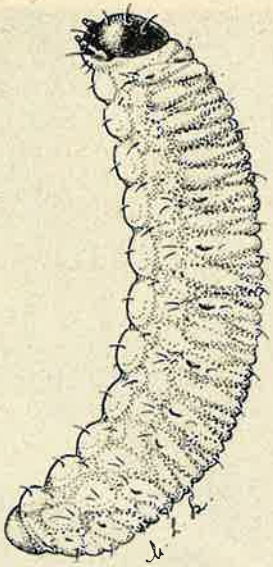
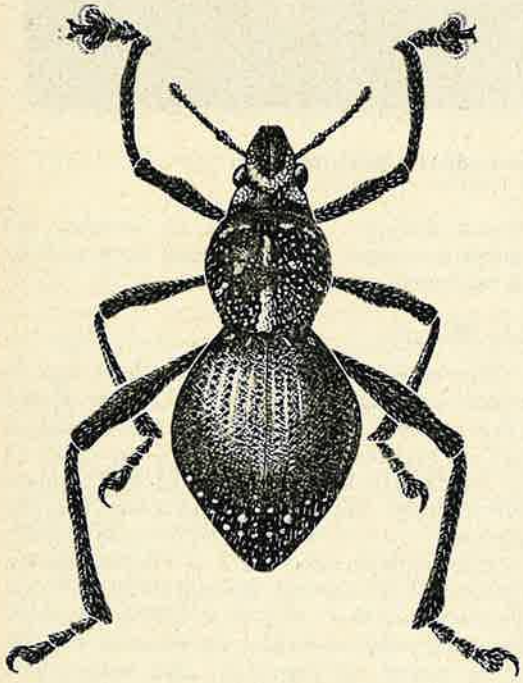


Plate IV.—(top left hand) *Pantorhytes plutus* Oberth. (adult).

Plate V.—(below left hand) *Pantorhytes szentivanyi* Mshl. (adult).

Plate VI.—(above) *Pantorhytes proximus* Fst. (larva).



alive in cages for as long as 190 days and have laid up to 300 eggs in that period, at the rate of one or two per day. The time elapsing between emergence of the adult and oviposition is not known.

Host Plants.

The principal indigenous plant which is host to *Pantorhytes* is the regrowth species *Pipturus argenteus*, although *P. proximus* has also been recorded from *Schummansia lenningsii*. Doubtless there are other native host plants which have not been recorded, although *Pipturus* is evidently the plant to guard against in the neighbourhood of newly established plantations.

Damage.

The main damage is caused by the larvae (Plate VI) which extensively bore in the sapwood. This has the effect of seriously weakening the tree, and even causing its death if the attack is sufficiently severe. Often, particularly in young trees where the bark is still smooth,

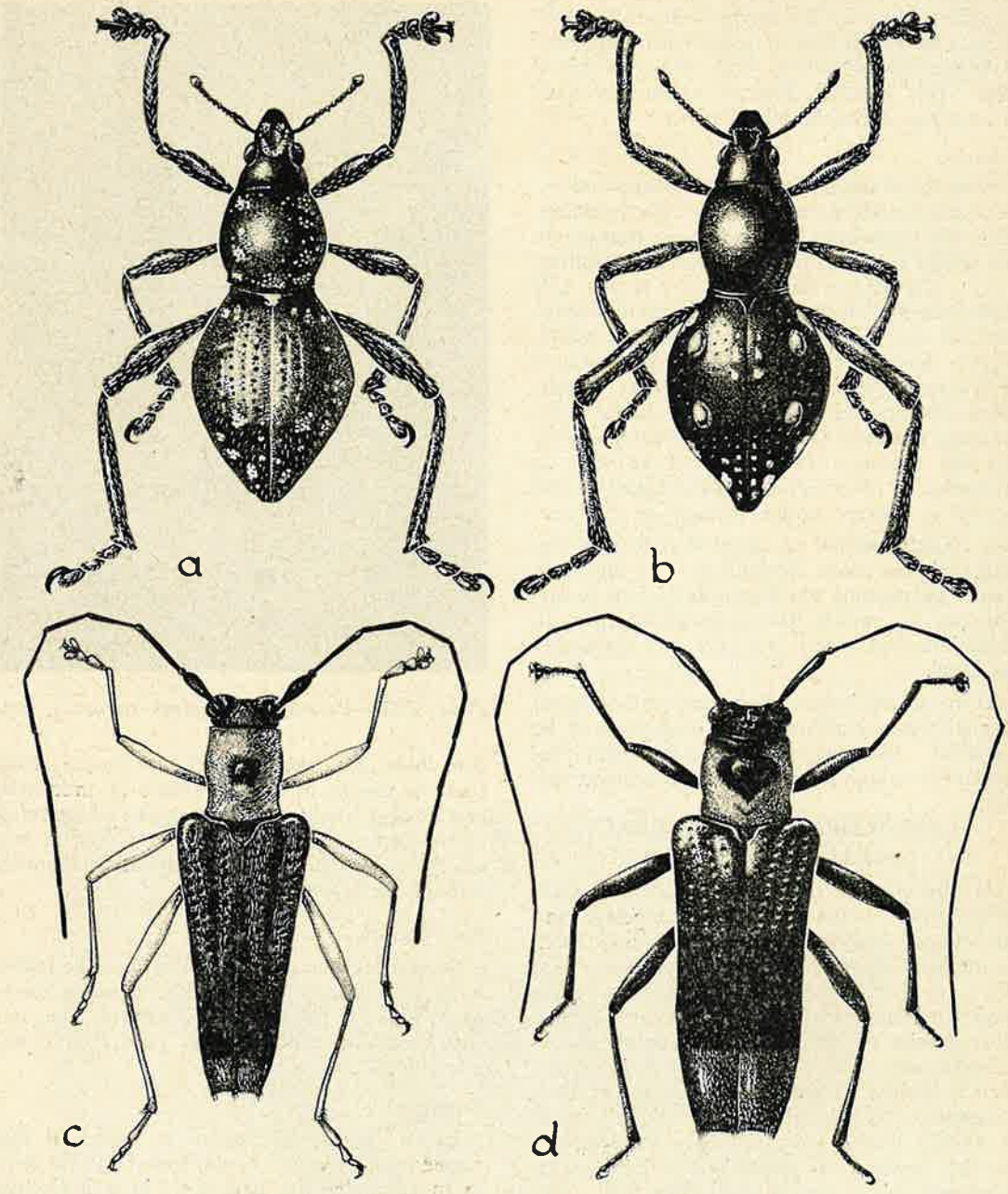


Plate VII.— a *Pantorhytes biplagiatus* Chevr.
b *Pantorhytes quadripustulatus* Gestro.
c *Glenea aluensis* Gah.
d *Glenea lefebueri* Guer.

the eggs are laid in the jorquette, and the subsequent feeding by the larvae weakens the tree to such an extent that it splits when subjected to undue strains such as high winds or heavy rain. This type of damage is common with *P. proximus* in the Morobe District.

Control.

Removal of all nearby *Pipturus* is the first requirement in attempting control. The establishment of a mechanical barrier between host plants and uninfected cacao trees is a useful controlling factor. The effectiveness of such a barrier will depend on its " obstruction value " to the movement of the weevils. Suitable barriers which suggest themselves are *Imperata*, dense stands of *Leucaena glauca*, taro or sweet potato. Mechanical cutting, and removal of the larvae from the cacao trees can achieve good results provided that the operation is commenced as soon as infestation is observed and care is taken in the cutting to prevent undue damage to the tree.

A reliable method of chemical control of the adult has not been devised so far, but if a regular programme of plantation hygiene is carried out, this would have a beneficial effect in maintaining the weevil numbers at a reasonably low level.

There are indications that treatment of larval channels by various insecticides may prove to be beneficial. However, these trials have not proceeded far enough to warrant a firm recommendation.

LONGICORN STEM BORERS.

Lamiidae—several species.

At the present time, *Glenea aluensis* Gah. (Plate VII), in the Bismarck Archipelago and the Solomon Islands, and *Glenea lefebueri* Guer., on the mainland of New Guinea including West Irian, are the commonest representatives of the species of longicorns found in cacao. Several other species of different genera occur also in different parts of the Territory, but their importance is limited by the localized nature of their occurrence. The longicorns are primarily pests of heavily shaded areas and so are commonest on the borders of plantations adjoining the rainforest, and in over-shaded cacao.

Life History.

Few details are known about the life history of these longicorns beyond the fact that the larval and adult stages are somewhat shorter

Plate VIII.—*Pantorhytes* damage to cacao, n.b. adult.

than those of *Pantorhytes*. *Glenea novemguttata* Cast., a species of *Glenea* found in Indonesia, lays its eggs singly on the lower part of the trunk of the cacao, and the young larvae feed at first on the bark, later making serpentine channels through the sapwood.

Host Plants.

Several regrowth trees are known to be native hosts of *Glenea*, although infestation is infrequent and the need for their removal does not arise as it does with *Pipturus* (and *Pantorhytes* infestations).

Damage.

In all species the damage is similar to that caused by *Pantorhytes* except that the larvae tend to move under the bark e.g., in a horizontal direction and are more likely to kill the tree (Plate IX). The larvae are subcylindrical in shape with an enlarged thoracic region and prominent intersegmental constrictions. They are white to creamy yellow in colour. The

Plate IX.—Longicorn channel in cacao.

longicorn larval tunnels can be distinguished from those of *Pantorhytes* by the presence of masses of fibrous frass which are ejected from the tunnels. The frass from *Pantorhytes* tunnels is usually very wet and contains no fibrous matter.

Control.

The larvae may be killed either by mechanical removal from their channels with a knife or by the fumigation effect of a small quantity of 15 per cent. Dieldrin applied over the channels.

CACAO DEFOLIATING CATERPILLARS.

Achaea janata L.
Ectropis sabulosa Warr.
Hyposidra talaca Wlk.
Tiracola plagiata Walk.

1. *ACHAEA JANATA* L.

Achaea janata is a moth belonging to the family Noctuidae ; it occurs from Malaya to Australia and has a particularly wide range of host plants. The adult (Plate X) is a greyish brown moth with a wingspan of 2½ inches, while the caterpillar, a semi-looper, (Plate XI) is a greyish-blue with black and white markings and two red protuberances on the eighth abdominal segment, although in their middle instars they may be predominantly black or brown.

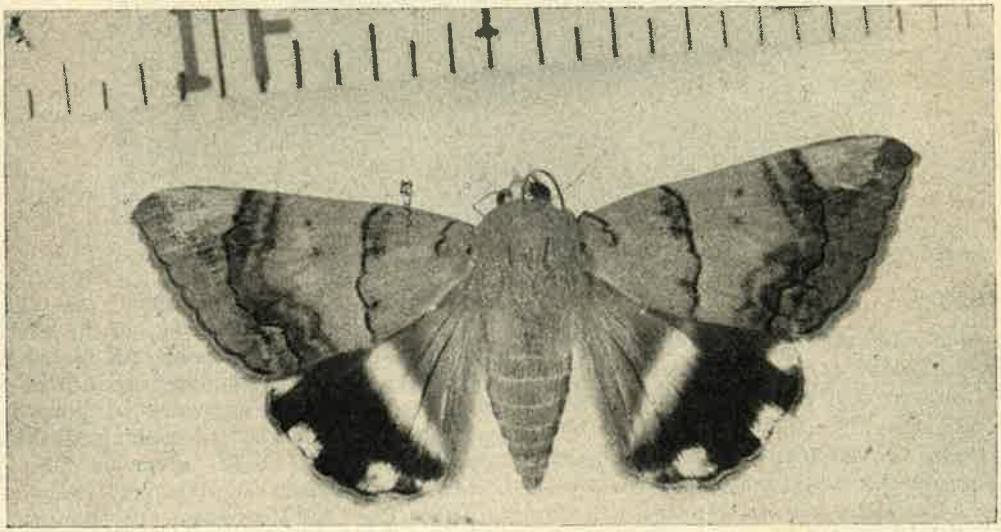


Plate X.—*Achaea janata* L. (adult).

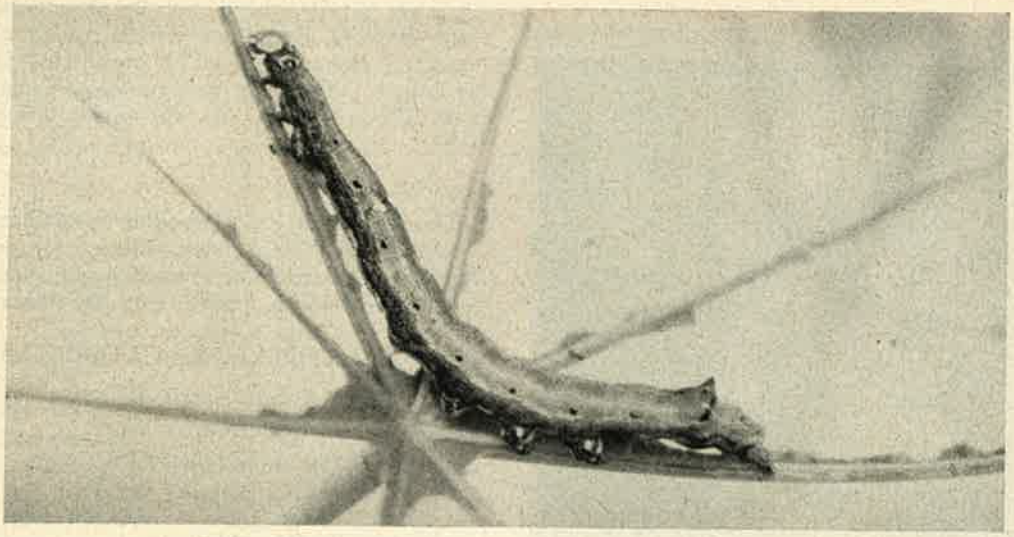


Plate XI.—*Achaea janata* L. (larva).

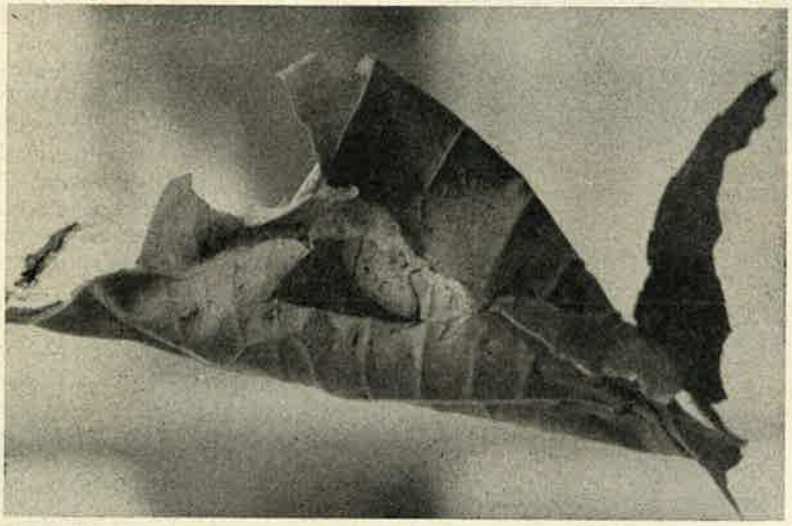


Plate XII.—*Achaea janata* L. (pupa).

Life History.

The total life cycle covers a period of 32 to 38 days, including a pre-oviposition period of ten to fourteen days and a caterpillar stage of 11 to 17 days. The adults can live for up to three weeks, though females exhausted by egg-laying usually die within ten days. The rate of egg-laying is high—200 to 250 eggs the first night, gradually dropping to 60 or 70 on the fifth night, with a total of about 600. Eggs are laid at random over the surface of the leaves and stem, batches seldom containing more than a dozen eggs, but this figure may sometimes rise as high as 40 eggs. The eggs are a pale green at first, changing to blue with red markings as the caterpillar developes inside. Pupation takes place in a cocoon made from the leaves of the host plant (Plate XII) or, frequently from leaf litter underneath the host tree.

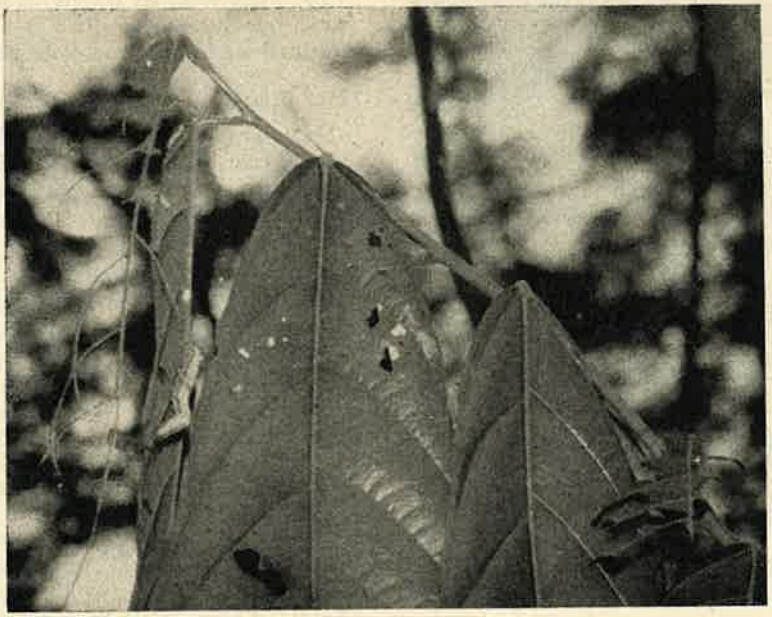


Plate XIII.—*Achaea janata* L. (damage).

Host Plants.

A. janata has been recorded on rubber, *Albizzia*, castor bean, crotons, peanuts, cacao and many other plants.

Damage.

The caterpillars feed only on the cacao flush (Plate XIII), and not on the hardened and mature leaves. First instar caterpillars initially attack the under surface of the leaf, but soon commence eating the remainder until only the midrib is left. Under conditions of severe attack the growing point and the epidermis of the young shoot is eaten, which kills it and causes excessive branching with subsequent malformation of the tree.

Control.

Good control has been obtained by the use of DDT sprays. On young cacao, up to about nine feet, the most economical method is to use knapsack sprayers and high volume spraying with 0.25 per cent. DDT. On larger trees, high volume spraying is not practicable under Territory conditions owing to the large amounts of water required, so a low volume or misting technique is employed. Power-driven shoulder-mounted misting machines are used with a 2.5 per cent. DDT solution. Spraying with knapsacks requires four to eight gallons per acre (for young cacao), and the misting machines four to six gallons (mature trees), depending on the size of the trees being treated.

The treatments must be repeated as required, although a maximum interval of two weeks is required to maintain adequate control.

An 0.2 per cent. mixture of " Sevin " in water, used as a spot spray on young cacao, with a knapsack sprayer, gives good results with a very quick knockdown. All the larvae are affected within minutes, and fall to the ground where they rapidly die.

2. LOOPER CATERPILLARS.

***Ectropis sabulosa* Warr. and *Hyposidra talaca* Wlk.**

E. sabulosa and *H. talaca* are members of the moth family Geometridae, and their larvae are known as " loopers " or " looper " caterpillars because of the characteristic mode of locomotion (Plate XIV).

Plate XIV.—" Looper " caterpillar of *H. talaca.*

The larvae of both species are similar in colour, though *Hyposidra* is generally a greenish colour, rather than the yellowish brown of *Ectropis*. *Ectropis* has a more pronounced thorax which gives it a slightly humped appearance, and a definite black spot on each side of the body one third of the body length from the head.

The adult of *Ectropis* is a fawn or grey coloured moth which is commonly found sitting, with wings spread and tightly pressed against the surface, on cacao and *Leucaena*. It is quite hard to locate with a casual glance as it resembles a small irregular patch of lichen. The adult of *Hyposidra* is a smoky black moth which is freely attracted to lights in large numbers when there is an infestation present.

Life History.

Very little is known of the life history of these two insects. *Leucaena* is apparently the preferred host for oviposition, probably because it provides more hiding places in the bark for the female to conceal her eggs. The larvae hatch out on *Leucaena* and produce and use silken threads to descend and ascend the host plants. When they reach cacao with suitable flush they attack it in the same manner as *Achaea* and *Tiracola*.

The mature larvae fall or walk to the ground where pupation takes place in a cell which is excavated an inch or so below the surface.

Host Plants.

Hyposidra has been recorded on cinchona, coffee, kenaf, tea, tung oil, tamarind and derris as well as cacao and *Leucaena*. *Ectropis* probably has a similar range of hosts.

Damage.

The damage is similar to that caused by *Achaea* and *Tiracola*.

Control.

Control is also as for the other flush defoliating caterpillars. When misting older cacao it is desirable to include the *Leucaena* as well.

3. CACAO ARMYWORM.

Tiracola plagiata Walk.

Tiracola plagiata is capable of causing serious damage to many agricultural crops ; however, it is relatively unimportant as a pest in tropical countries as it is usually controlled by parasites and predators. It has recently assumed the status of a major pest in the cacao growing areas around Popondetta in the Northern District of Papua.

The caterpillar of *Tiracola* is smoky black with a prominent cream to yellow band along both sides of the abdomen. The head is reddish-brown in colour. The larvae produce silken threads which they use for descent and ascent of the trees—however, after the larvae reach the fourth instar the thread is no longer used for this purpose, possibly because the insect is too heavy. The adult is light grey to fawn in colour, with a distinct black V-shaped mark on the anterior margin of the forewings. It is strictly nocturnal, like *Achaea janata,* and is rarely seen in the plantation during the day.

Life History.

The eggs are laid in batches of 200-1,200, generally on the underside of new flush leaves of cacao. They hatch in about four days, and the young larvae immediately commence feeding. The larvae undergo six instars then, when mature, pupate in small cells excavated in the ground. The adults emerge at dusk or during the night.

Table A.

Stage of life cycle	Days' duration
Eggs	3½-4
Larva	15-17
Pre-pupa	4
Pupa	10-15
Pre-oviposition	4
TOTAL—egg to egg	35-40

Host Plants.

Tiracola has an extremely wide range of host plants, those in the Territory including rubber, sweet potato, tapioca, *Crotalaria*, cacao, *Leucaena*, taro, milkweed, crotons, coffee, bananas and many others.

Damage.

The young larvae at first skeletonize the leaves, leaving the veins which are too hard for them. As the larvae grow, they eat all the soft young tissues on the plant, even killing the growing point in a severe infestation. They do not eat the harder tissues and older leaves, thus mature trees are not greatly damaged unless the attacks recur continually. In young unramified trees, the killing of the growing point can result in grossly mis-shapen trees which require extensive maintenance. Also bearing can be set back considerably, depending on the severity of the attack.

Control.

At present the natural parasites and predators in the Popondetta area are in insufficient numbers to exert any satisfactory degree of control, so reliance has to be placed on the use of insecticides.

Under the conditions at Popondetta, *Tiracola* appears in waves, at five to six weeks intervals, so that spraying can be timed to coincide with the most susceptible stage, which is when the insects have just hatched, and are still clustered together around the hatching site.

DDT, as an 0.25 per cent. high volume spray on the young trees, or as a 2.5 per cent. mist on the older trees, gives good control.

MEALYBUGS, SCALE INSECTS AND APHIDS.
Coccidae.
Aphididae.

Scale insects and mealybugs have been recorded from all parts of the Territory as minor pests of cacao. The common mealybug is *Planococcus citri* (Risso) (Plate XV) but there are many other species which are less common. Aphids also are relatively common, though they do not appear to cause significant damage.

Life History.

The life history of these insects has been studied in only a few cases. Many kinds of reproduction are known, including production of eggs and live nymphs from mated and unmated insects. The eggs are protected in various ways, sometimes in a cover of waxen threads (as by the mealybugs) or under the scale-like covering of the female. The first instar nymphs have functional legs and by their mobility ensure the dispersal of the species. The later nymphal stages and the adult females of scale insects and mealybugs are stationary, being attached to the host plant by their mouth-parts. The adult males are often winged, always have legs, and are mobile. Aphids have both winged and wingless forms.

Many scale insects and mealybugs secrete honeydew, which makes them attractive to ants. Many different species of ants are found in attendance, and when present in large numbers make conditions around the cacao very unpleasant. These ants protect the scale insects and mealybugs from predators and so lead to greatly increased multiplication of the pests (Plate XV). The ants also carry them about and find new host plants to colonize.

Plate XV.—Mealybugs attended by the Fire Ant on cacao, *Solenopsis geminata* var. *rufa*.

Host Plants.

Aphids, scale insects and mealybugs are found on almost all plants.

Damage.

The order *Hemiptera* (commonly known as bugs) probaly cause more injury to plants than any other group of insects, and aphids, scale insects and mealybugs are amongst the most destructive. These insects are capable of transmitting many virus diseases (*Planococcus citri* and *Ferrisiana virgata* (Ckll.), widespread in the Territory, transmit swollen shoot disease in West Africa, and are vectors of a strain of this disease in Ceylon), but fortunately do not appear to be virus carriers in the Territory.

The most important factor bearing on the damage caused by these insects is their extremely rapid rate of reproduction. When the numbers become high they kill the growing points, and cause distortion of the leaves and tips by the mechanical damage to the cells of the plant and the withdrawal of plant juices. In the absence of any transmitted disease, small numbers do not cause serious damage. Although large numbers are often seen on cacao pods they do not seem to affect them, except when the pod is very small.

Control.

In most cases, natural enemies maintain low population levels, however, when the colonies of these pests are tended by very offensive ants such as the Fire Ant and the Tree Ant, then the enemies are prevented from reaching their prey. Thus it has been found that good control of the scale insects and mealybugs can be obtained by destroying these ants.

Ants can be controlled by spraying the base of the trees and the surrounding ground with a solution of either 0.2 per cent. Chlordane or 0.5 per cent. Dieldrin. It is desirable to treat the nests at the same time. If direct insecticidal treatment of the scale insects of mealybugs is required, then a standard white oil/malathion mixture (containing 1½ pints of 50 per cent. malathion concentrate and 2½ gallons white oil to 100 gallons of water), will give good control when applied as a high volume spray.

CACAO CAPSIDS.

Pseudodoniella spp.

Helopeltis clavifer Walk.

The capsids are the most economically important of the plant bugs attacking cacao, five species of *Pseudodoniella* (Plate XIX), as well as *Helopeltis clavifer* (Plate XIX), being recorded from cacao. *Pseudodoniella* are mostly reddish brown or black, fairly stoutly built and about ½ inch long with a typical protuberance between the wings in the middle of the back. *Helopeltis* is more lightly built with longer, fragile legs and antennae. Their colour varies from red to black with intermediate forms.

There are also a number of other species which feed occasionally on cacao, mainly on young trees, but which are of minor significance.

Life History.

For *Pseudodoniella*, the period from the deposition of the egg to the emergence of the adult is 25 to 30 days—12 days as the egg and the remainder in the various nymphal stages. The eggs are laid beneath the surface of the pod and as soon as the nymphs hatch they commence feeding. Few details of the life of the adult and its habits are known as they are extremely difficult to handle in the laboratory.

Little is known about the biology of *Helopeltis*, though it is probably similar to *Pseudodoniella*.

Host Plants.

Capsids are commonly found feeding on various native species of *Ficus* (wild figs). *Helopeltis* also attack a number of cultivated plants, including tea and sweet potato.

Damage.

Capsid attacks are confined primarily to the pods (Plate XVI), though they can cause extensive tip die-back, particularly on young trees before the pods are formed (Plates XVII and XIX). The lesions caused by the capsids are found mainly around the base of the fruit, where the insects seek shelter, and as each individual can feed in 40 to 80 places each 24 hours, actual mechanical damage can be high.

A considerable percentage of pod loss is caused by secondary infections by the fungi *Gloeosporium* and *Phytophthora*.

Plate XVI.—Injury to cacao pods by capsid.

Control.

The established method of control is by the use of BHC dust—a common type being "Gammexane No. 10 Dust", which contains 1.3 per cent. of the active gamma isomer of BHC. Any other dust with a similar formulation is suitable. Usually two treatments, of ten pounds of dust per acre, applied at an interval of about three weeks, give good control. Another method which gives good control is the use of lindane as a mist (lindane is the purified active ingredient from BHC) with one ounce of the concentrate per two gallons of water. An Endrin mist has also been found to be successful (half ounce of endrin concentrate per two gallons of water), but great care must be taken when using endrin as it is very poisonous.

Misting is very much cheaper than dusting, but dusting is faster, and can utilize cheaper machinery (see section on spraying and dusting techniques).

AMBLYPELTA.

Amblypelta spp.

Five species of the coreid bug, *Amblypelta* have been recorded as feeding on cacao pods. The most important species is *Amblypelta theobromae* Brown (Plate XIX), which is found in parts of the Morobe District of New Guinea and the Northern District of Papua. *Amblypelta* is a light brown coloured bug about three-quarters on an inch long, all the species being quite similar in appearance.

Plate XVII.—Injury to young cacao by capsid.

Life History.

Very little is known about their life history apart from the fact that one generation lasts from six to seven weeks.

Damage.

The damage caused by *Amblypelta* is similar to that caused by the capsids, but the brown scars on the surface of the pods are larger and more evenly distributed. When the damage is severe the scars may run together, forming large areas of dead tissue. As with the capsids, the lesions may be entered by secondary fungi. Young pods attacked by *Amblypelta* become severely distorted (Plates XX and XXI).

Host Plants.

Amblypelta attacks many different plants, but most species are common on tapioca. *A. cocophaga* causes serious nutfall of coconuts in the British Solomon Islands Protectorate and the Bougainville District.

Control.

It has been found that spraying the pods only with 0.15 per cent. Dieldrin in water gives good control. Control measures as applied for capsids are also effective.

CACAO TERMITES.

Neotermes spp. and other species.

There are a number of species of termites found on cacao, the most important being *Neotermes* spp., which can cause considerable damage to cacao and *Leucaena*. One species, common in the Gazelle Peninsula, attacks through dead wood in the aerial parts of the tree. Another, found in New Ireland, attacks through the roots, tunnelling through the ground from one tree to another.

Neotermes is a larger species of termite, with the workers up to three eighths of an inch long, and the soldiers and alates up to half an inch.

Life History.

In common with other termites, *Neotermes*, known as the "Giant" termite, has distinctly differentiated castes—the male and female ("king" and "queen"), soldiers and workers. The colonies are found entirely inside the attacked tree, with no external runways. The external nests and runways found on cacao and other trees belong to other species which attack only the dead wood on the tree.

Swarming takes place two or three times each year, and species found in the Gazelle Peninsula then seek out dead wood which is still attached to the tree (Plates XXII and XXIII). It appears necessary that initial colonization be through dead wood which has not decayed and is still quite solid. Other species of *Neotermes* gain entry to the tree via the top or lateral roots, and here the damage is seldom observed until the tree has collapsed at ground level or the jorquette.

Damage.

The termites, having penetrated into the tree through dead branches or roots, then tunnel into the green timber. Eventually, the tree is weakened to such an extent (Plate XXII) that it falls when subjected to heavy strain due to wind or rain.

Plate XVIII.—Dieback of cacao caused by the capsid *Pseudodoniella*. The chupon in *Plate* XVII was taken from this tree.

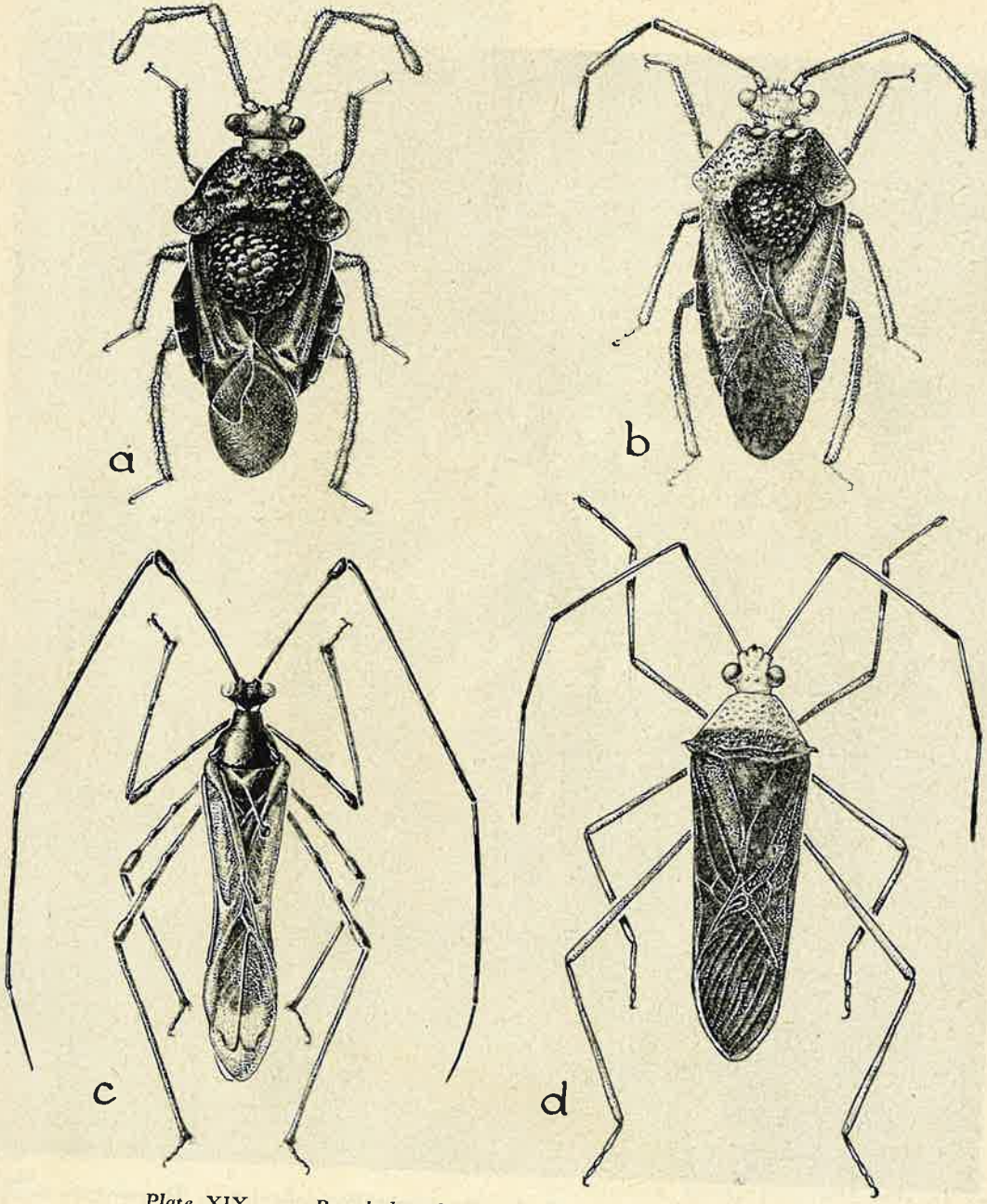


Plate XIX.— a *Pseudodoniella typica* China & Carv.
b *Pseudodoniella laensis* Mill.
c *Helopeltis clavifer* Walk.
d *Amblypelta theobromae* Brown.

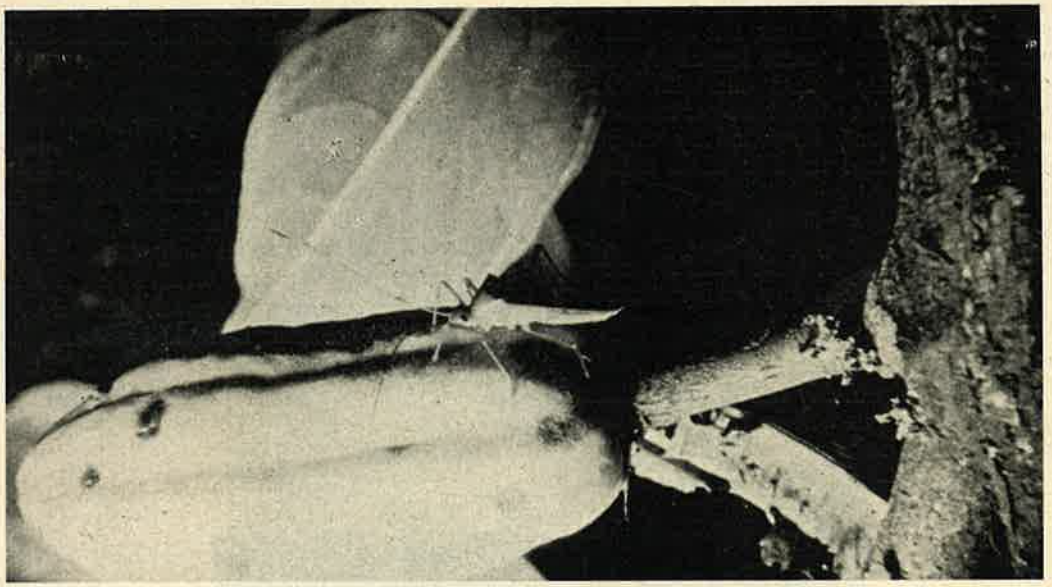


Plate XX.—Injury to cacao pod by *Amblypelta.*

Plate XXI.—Injury to cacao pod by *Amblypelta.*

Externally, the presence of the termites inside a tree is often hard to detect, but the bark over the nest usually has a water logged appearance and can be readily picked out with practice. The younger colonies which have not made extensive tunnels can only be found by cutting or breaking off the dead wood in which the attack was initiated.

Host Plants.

The native hosts of these termites are not known. On plantations they readily attack both cacao and *Leucaena*.

Control.

As *Neotermes* probably attacks many different trees surrounding, as well as inside, the plantation, and the colonies are often hard to detect, it can be expected that continual re-infestation will occur. Thus control of this termite has two aspects :

1. *Control of colonies already present.*

All trees in the plantation, including the cacao and *Leucaena*, should be checked and any nests present treated. As the infestation usually commences in dead wood, all such wood should be cut open and examined. When a nest is found, an opening is made in the upper part and a solution of 0.05 per cent. Dieldrin in water poured into it. Enough insecticide should be used to saturate the nest thoroughly. This has been found to average out at about one-third of a pint of solution per nest.

Plate XXII.—The shade tree *Leucaena glauca* almost hollowed out by *Neotermes*.

Plate XXIII.—A badly pruned branch of cacao which has been attacked by *Neotermes*.

2. *Prevention of future infection.*

As dead wood on the trees provides an entrance for the insects, care should be taken when pruning that when a branch is removed, the cut is made, preferably with a saw, as close as possible to the point of origin of the branch, flush with the main branch or trunk. The wound should then be covered with a protective covering. If pruning is carried out correctly, callus tissue will grow over the wound and thus prevent entry of the termite.

Once initial control has been gained, it can be maintained by assuring that pruning operations are carried out correctly, as well as regularly, and that all nests are treated as they are found. The control procedures are best inserted as a regular feature of the normal cultural programme.

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